

Cartilage (crissman)

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3:09 PM

Learning Objectives

- Describe and identify the characteristic morphology and function of the 3 different types of cartilage (hyaline, fibrocartilage and elastic).

Type is based on type of extracell fiber

	Morph	Function	Location
Hyaline	Scattered, large round chondrocytes* Large amount of ECM* Amorphous, pale blue Avascular matrix Surrounded by layer of perichondrium (dense irregular CT)	Structural support Withstand pressure and shear Slippery Rapid growth	Costal Trachea, bronchi Larynx and nose Articular cartilage of synovial joints Fetal skeleton
Fibrocartilage	Chondrocytes (round) aligned between bundles of collagen. Scant ground	Cushion and absorb Tough, not rigid (Herniated disk: extrusion of nucleus pulposis)	Public symphysis Intervertebral disks > annulus fibrosus (keeps disk from slipping) >nucleus pulposis Junction between tendon and bone.
Elastic	Lots of Elastic Fiber Some Co2 Requires special (black) stain to visual fibers (random orientation) Similar ground to hyaline cartilage; not as much	Resilient support but greater flexibility and return to original position.	Auricle Epiglottis

- Describe the development of cartilage from **mesenchyme**.

Mesenchyme cells condense to form procartilage.
Secrete cartilage matrix.
Few BV --> low O2 --> cartilage formation

- Integrate the characteristics of individual components of CT to the structure and function of cartilage.

Chondrocytes	Located in lacunae	Mature, maintains ECM
Chondroblast	Located in lacunae Isogenous group (cell nest)	Cell division, secreting new ECM
Perichondium	Surrounds cartilage	Supplies nutrients and appositional growth
Aggrecan Aggregates (and other proteoglycans)	Everywhere	Diffuses nutrients, mechanical resistance, very slippery
Glycoproteins		Binds cells and calcium to ECM.
Fibers	Pericellular capsule (immediately next to cell, protects cell)	Very thin (100A); does not form fibers

- Describe how the morphology of each type of cartilage is specialized to meet the function of that cartilage.

The aggrecan and other proteoglycans give cartilage the strength and resilience.
Extra co1 fibers give fibrocartilage greater strength.
Extra elastic fibers give elastic fiber greater flex and spring-back.

- List and describe how the 3 types of cartilage are classified based on the most prevalent fiber type in matrix (special stains are needed to differentiate the types).

Hyaline	Type 2	
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Elastic	Elastic + type 2	Special stain
Fibro	Type 1	

- Describe the composition, location and function of the **perichondrium** and its fibrous and chondrogenic layers.

Found outside tissue proper. Composed of two layers:

	Composition	Location	Function
Fibrous layer	Fibrous dense irregular w/ BV	Outer layer	Supplies nutrients to cartilage
Chondrogenic layer	Cells that differentiate into chondroblasts and begin secreting ECM		Appositional growth

- Describe the morphology of the **ground substance** and how it permits diffusion of nutrients and wastes throughout cartilage without blood vessels being present.

Abundant, between cells

Rich in proteoglycans (chondroitin-4 and 6). Low in hyaluronic acid

Staining means more base (attracts acidic dye)

Territorial matrix (capsular)	Immediately around cell. Darker staining. Few collagen fibrils
Interterritorial matrix	Between cells Lighter staining.

Proteoglycan aggregates (HA w/ GAG) holds interstitial fluid for diffusion of nutrients.

All cartilage nutrients come from BV in fibrous layer.

- Describe how the **proteoglycans** of the ground substance help maintain the architecture of the ground substance and enables the cartilage to withstand pressure and shear forces.

Aggrecan (c4,6S and keratan) and aggrecan aggregates.

Aggrecan aggregates resist compression and is slippery.

- Describe how the morphology of the cartilage ground substance permits articular cartilage to be quite **slippery** and facilitate movement of joints.

- Describe the specialized structure of **hyaline articular cartilage** to meet the special needs of joints.

Structure	Properties
Surface cartilage	Lacks perichondrium! Cartilage on cartilage action --> slippery Large Co2 fibers
Calcified cartilage	Layer away from surface -> more strength and support
Subchondral bone	Layer of avascular bone for support Nutrients from diffusion.

Bonus:

Ground substance has glycoproteins

Chondronectin	Adherence of cell membrane to ECM (integrins)
Chondrocalin	Calcium binding in ECM

- List and describe the two modes of growth by cartilage (appositional and interstitial growth).

Appositional	Growth on outside of the tissue. Done by perichondrium
Interstitial	Growth from within

- Describe the process of **cartilage regeneration** and what special problems there are with regeneration of articular cartilage.

In articular cartilage:

- Poor nutrition
- Fractures or torn cartilage does not regenerate via mitosis
- To repair must:
 - Punch through subchondral bone to allow chondroprogenitor cells to migrate up.
 - Continuously move joint to stimulate repair

Other repair options:

- Nature uses fibrocartilage

2. Subchondral bone graft
3. Autologous bone graft
4. Tissue culture grafts
5. Injection of hyaluronic acid.

Be able to classify and describe the different **joints** of the body both structurally and functionally.

Functional

Synarthroses	Not movable
Amphiarthroses	Slightly movable
Diarthroses	Freely movable most common

Structural

Main	Sub	Description	Movement
Fibrous		No cavity bones held together by thin layer of fibrous tissue or dense fibrous ct	
	Sutures	Between skull bones Lots of skull joints	synarth
	Syndesmoses	Bones united by dense fibrous tissue	amphi
	Gomphoses	Teeth in sockets Periodontal ligament holds tooth root to bone	Synarth
Cartilagenous		No cavity Bones united by cartilage	
	Synchondroses	Hyaline cartilage Epiphyseal plates (temp) Costal cartilage	Synarth
	Symphyses	Fibrocartilage pubic back disk	Amphi
Synovial		Most common Common characteristics: 1. Synovial cavity 2. Articular cartilage (hyaline) 3. Articular capsule 4. Synovial membrane 5. Synovial fluid a. Hyaluronic acid b. Lubricin (glycoprotein) c. Nutrient to articular	Diathrosis
	Gliding	Interphangeal (finger)	
	Hinge	elbow	
	Pivot	Prox radial ulnar (wrist), atlantoaxial (base of head)	
	Ellipsoid	Radiocarpal	
	Saddle	Carpal-metacarpal of thumb	
	Ball and Socket	Shoulder, hip	

Be able to describe the changes that take place in a joint affected by either **osteoarthritis** or rheumatoid arthritis.

Osteoarthritis	Synovial joints most common non-inflammatory progressive deterioration fibrillation of articular cartilage (loss of ground) proliferation of cartilage at periphery Replacement of cartilage spur w bone spur
Rheumatoid	Inflammatory auto-immune at synovial membrane membrane thickens. fluid secretion increases. Pressure causes pain and tenderness. Pannus of tissue forms across cartilage. Erodes cartilage



Know the meaning of the following terms and how they are applied to cartilage structure and function.

Chondrocyte	
interterritorial matrix	
isogenous groups	
Chondroblast	
territorial matrix	
cell nests	
chondrogenic	
capsular matrix	
collagen type II	
proteoglycan subunit	
chondronectin	
slipped (ruptured) disc	
proteoglycan aggregate	
arthritis	
annulus fibrosis	
lacuna	
intervertebral discs	
nucleus pulposus	
synarthrosis	
fibrous joints	
amphiarthrosis	
cartilaginous joints	
diarthrosis	
synovial joints	